

UNIT PERFORMANCE TASK

How Can You Drop a Payload onto a Target?

As communities grow and extend into forest areas, the risk of loss, injury, or even death from wildfires grows as well. Ground crews are always at risk of a sudden shift in wind direction. Firefighters incorporate a wide variety of tools to fight a fast-moving fire. Large airplanes full of water and fire-retardant chemicals help keep the frontlines safe by dropping their payloads at precise areas where the risk is greatest. Once the key position is determined, the pilot flies over, keeping the plane at a safe speed and altitude. Crew members release the mixture of water and chemicals right where it is needed. You are tasked with calculating where the crew should start the flow in order to hit the designated target.

Use your Evidence Notebook to record your notes, statements, questions, and data.

Crews on the ground are relieved when the chemicals reach the right target.



Source: ©lordache Gabriel/Alamy

1. DEFINE THE PROBLEM

With your team, write a statement outlining the problem that you will solve. Decide what information you will need to solve the problem.

2. CONDUCT RESEARCH

With your team, investigate how firefighting planes operate and the normal conditions that will guide your solution.

- What is the typical height above the ground that a plane can safely fly?
- What is the typical speed of a plane making a drop of fire-retardant materials?
- How long does it take to drop the entire load?

3. USE A MODEL

Draw a map that shows the location of your drop. The drop should be timed so that the middle part of the flow lands at the target location. Indicate on your map the direction of approach of the plane and the expected area on which the chemicals will land.

4. DESIGN A SOLUTION

Use Newton's laws and what you have learned about projectile motion to design a drop that hits the target. Calculate the forces acting on the falling chemicals, their initial horizontal speed, and the time it will take to reach the ground. Ignore air resistance for these calculations.

5. COMMUNICATE

Write instructions for the crew giving them specific directions about where they should begin the drop. Include instructions for the pilot about speed and elevation above the ground during the approach.



CHECK YOUR WORK

Once you have completed this task, you should have the following:

- a clearly defined problem statement with questions about airspeed, elevation, and distance that are answered in the final calculations
- information about how airplanes approach the drop zone
- a map showing the target and the range of the drop around the target
- clear instructions to the crew about the approach and the drop of the payload over the target